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Erstveröffentlichung in / First published in:

Waste Management & Research. 2017, 35(4), S. 332 - 345 *[Zugriff am: 19.08.2019]*. SAGE journals. ISSN 1096-3669.

DOI: https://doi.org/10.1177/0734242X16672319

Review Article

WM&R

Waste Management & Research
2017, Vol. 35(4) 332–345

DOI: 10.1177/0734242X16672319
journals.sagepub.com/home/wmr
SAGE

Integrated environmental policy: A review of economic analysis

Hans Wiesmeth[1,2] and Dennis Häckl[3]

Abstract

Holistic environmental policies, which emerged from a mere combination of technical activities in waste management some 40 years ago, constitute the most advanced level of environmental policies. These approaches to environmental policy, among them the policies in integrated waste management, attempt to guide economic agents to an environment-friendly behaviour.

Nevertheless, current holistic policies in waste management, including policies on one-way drinks containers and waste electrical and electronic equipment, and implementations of extended producer responsibility with further applications to waste electrical and electronic equipment, reveal more or less severe deficiencies – despite some positive examples. This article relates these policy failures, which are not necessarily the result of an insufficient compliance with the regulations, to missing constitutive elements of what is going to be called an 'integrated environmental policy'.

This article therefore investigates – mostly from a practical point of view – constitutive elements, which are necessary for a holistic policy to serve as a well-functioning allocation mechanism. As these constitutive elements result from a careful 'integration' of the environmental commodities into the economic allocation problems, we refer to these policies as 'integrated environmental policies'. The article also discusses and illustrates the main steps of designing such a policy – for waste electrical and electronic equipment and a (possible) ban of Glyphosat in agriculture.

As these policies are dependent on economic and political stability with environmental awareness sufficiently developed, the article addresses mostly waste management policies in highly industrialised countries.

Keywords

Integrated Environmental Policy, Holistic Environmental Policy, extended producer responsibility, WEEE Policy, integrated waste management, glyphosate

Introduction

Over the last decades, demands on environmental policies have fundamentally changed. The societal desideratum of a sustainable development integrating environmental and economic goals has certainly contributed to this development. Consequently, in particular in highly developed countries, more and more rather complex constructs, often associated with multiple economic and societal goals, complement the classical instruments, such as straightforward command-and-control policies regulating emissions of hazardous substances, for instance. Waste electrical and electronic equipment (WEEE) policies focusing on a 'design for environment' constitute examples for these special holistic approaches to environmental policy.

The development of waste management in general provides another interesting example in this context. Today, a functional 'integrated' waste management (IWM) system combines waste collection, treatment and disposal methods in a rather sophisticated way. The concept was evolved in 1975 from the mission statement of the Solid Waste Authority of Palm Beach County, Florida. According to this statement, the Authority would 'develop and implement programs in accordance with its Comprehensive Plan by integrating solid waste transportation, processing, recycling, resource recovery and disposal technologies' (McDougall et al., 2003: 21). Since then the concept has further developed, especially in highly industrialised countries, into a holistic approach to waste management comprising now – under the roof of the waste hierarchy – various waste management activities, such as avoidance of waste, reuse of discarded components, recovery and environmentally sound recycling. Bilitewski et al. (1994) initiated this development with a comprehensive discussion of all aspects of (integrated) waste management, and Wilson (1996) examined in this context 'the development of integrated sets of policy measures by countries around the world …' (Wilson, 1996: 389). Parallel to the changes in the comprehension of waste management, there

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was an adaptation of the technical infrastructure. Uyarra and Gee (2013) describe this complex process of a 'sustainable transformation of urban infrastructure' in the sense of moving 'away from landfill and towards more sustainable waste management' (Uyarra and Gee, 2013: 102) for the case of Greater Manchester (UK).

The latest step in this development has been taken by the European Union (EU) Commission with the 'Circular Economy Package' adopted at the end of 2015. Its goal is to enhance and accelerate the transition to a circular economy, also with funding from EU sources (see http://ec.europa.eu/environment/circular-economy/index_en.htm). In this context, one also has to mention the activities of the Ellen MacArthur Foundation, which, founded in 2009, has since then worked 'with business, government and academia to build a framework for an economy that is restorative and regenerative by design' (see https://www.ellenmacarthurfoundation.org).

As already indicated, this new holistic thinking on waste associated with IWM is of relevance for other environmental policy areas, too. This is true, for example, for extended producer responsibility (EPR), with its attempt to extend a producer's responsibility to the design and the post-consumer stage of a product's lifecycle. EPR, thus, plays an important role in WEEE policies. Observe that these holistic policies, besides environmental goals, typically also have the goal to stimulate research and to promote business activities in the respective field. Again, technical developments and environmental policies complement one another.

Thus, the research question arising in this context refers to the general applicability of these holistic policies as allocation mechanisms for environmental commodities. To put it another way: Assume that we have specific goals for a particular waste policy (reduction of waste, waste recovery and recycling quota, design for environment (DfE) for particular products, restriction of exports of waste commodities, …, or a combination of those goals), what are the constitutive elements of this waste policy, necessary to reach these goals, to work without deficiencies – to develop into an 'integrated' environmental policy?

This research question is not only of theoretical relevance. Current experience with a variety of holistic approaches from European countries shows that designing a fully functional environmental policy is anything but straightforward and simple. Existing environmental policies on WEEE, for example, give proof. Current WEEE policies seem to motivate excessive semi-legal export activities with WEEE often ending up in developing countries, which is certainly not the goal of WEEE policies. Babu et al. (2007) survey various global aspects of WEEE recycling, Ongondo et al. (2011) provide a global view of the management of WEEE and Schnoor (2012) highlights also the situation regarding e-waste in developing countries.

Systematic economic-minded approaches to this research question are still missing in the literature. This does not contradict the fact that many articles address aspects of these questions, and that various existing environmental policies achieve their goals. Wilson (1996), for example, refers to a 'combination of measures', including economic ones, for an IWM strategy (Wilson, 1996: 397), and Marshall and Farahbakhsh (2013) provide an interesting survey on the development of solid waste management including the associated literature.

Given this situation, the aim of the article is first of all to investigate the economic background of integrated environmental policies, associated with specific goals. We introduce and motivate constitutive elements, which are necessary for integrated policies to reach their goals. We call policies, satisfying these constitutive elements, 'integrated environmental policies', as this procedure implies the integration of environmental commodities into the economic allocation problems. The section 'The intrinsic nature of integrated environmental policies' explains this 'intrinsic' nature of integrated environmental policies and the associated research gap. 'The Methodology' introduces and discusses the methodology, whereas 'Constitutive elements of integrated environmental policies' presents the necessary structural properties of integrated environmental policies, the constitutive elements, in detail. Examples for more or less effective approaches in the context of waste management illustrate, or rather prove, their relevance. 'A proposal for an integrated WEEE Policy' presents a proposal for an integrated environmental policy for WEEE. The final section summarises the main results.

In conclusion, the article provides a systematic economic-minded approach, as well as practical insight into economic aspects of (integrated) environmental policies. More than 20 years of experience with holistic approaches have resulted in a large number of publications in prominent journals. Although many of these articles touch constitutive elements of integrated environmental policies in the sense of our approach, a theoretical and systematic economic approach to integrated environmental policies is still missing. The article presents some of the more recent publications in their relation to the constitutive elements of integrated environmental policies.

The intrinsic nature of integrated environmental policies

As already indicated, the concept of IWM has evolved from a mere technical handling of waste with an increasing emphasis on recycling, to a sophisticated system of waste management with a profound economic basis. Whereas earlier versions of IWM focused on the 'integration' of various activities, such as collection and treatment of waste, more advanced versions pay more and more attention to the 'integration' of the economic subjects relevant for a successful management of waste. Thus, not only the companies collecting, sorting, treating and recycling waste were addressed, but also households and production companies with their often-underestimated potential to reduce waste. Particularly this step requires guidance of the economic agents by means of an adequate policy, which accompanies or even initiates changes in the infrastructure. Uyarra and Gee (2013) refer to the 'significant technological, political and financial challenges' associated with the transformation of the waste management system in Greater Manchester (see the Abstract). The remaining step taken in this article is then considering a specific kind of waste, or rather reducing this waste, as an economic 'commodity', as an environmental commodity, and therefore 'integrating' waste appropriately into the economic allocation problems.

The 'allocation problems' refer to the basics of any economic system by addressing the questions of which commodities and how many units of them to produce in a certain time period, how to produce these commodities (environment-friendly, for example) and for whom. These fundamental problems have to be solved in any economic system, and they are solved in any economic system. Clearly, the state of the environment in a certain country is a consequence of the particular solution of the allocation problems with respect to the environmental commodities in this and, in view of global environmental commodities, potentially also in the neighbouring countries.

Thus, the 'integration' of environmental commodities into the economic allocation problems is quite natural. Owing to the public goods nature and the external effects associated with most of these commodities, it is not possible to extend the well-known market mechanism, the allocation mechanism in a market economy, straightforwardly to environmental commodities. The goal is, thus, to establish integrated environmental policies as appropriate allocation mechanisms – with properties related to those of the market mechanism.

In view of these remarks, the research gap addressed in this article refers to an up-to-now missing systematic approach to waste policies: What structural properties are necessary in order to reach their specific goals? These structural properties are of relevance for any waste policy, and they help to design functional policies.

The following section explains the methodology of this approach in more detail and provides also more information on the selection of the various examples applied in this article.

The methodology

The research question stated in the Introduction and the research gap elaborated in the section 'The intrinsic nature of integrated environmental policies' point first of all to a theoretical context: What structural properties are required for an integrated environmental policy to serve as an allocation mechanism for environmental commodities with specific policy goals? Current examples of holistic environmental policies from highly developed countries reveal more or less severe deficiencies. By analysing these deficiencies, we arrive at a set of necessary properties: If a concrete waste policy does not satisfy one or the other of these structural properties, then the policy need not be fully functional. The examples provide insight into this relationship and allow the conclusion that these structural properties are of relevance for any waste policy.

This helps to explain the selection of the examples presented in the article. In order to motivate the necessity of the structural properties, we have to find a policy violating one of the structural properties, and which does not reach its goals. Waste policies in developing countries seem to be easy candidates. However, in order to arrive at policies, which satisfy some of the structural properties, but not all, one has to look for more sophisticated policies. Those can be found in the industrialised countries, where the legal framework conditions are stable and allow for more elaborated policies.

Although most of the examples presented in this article are from Germany, it is, of course, possible to analyse the Dutch waste policy or the South Korean or Japanese approach to WEEE along the same lines. The example regarding a ban of a herbicide highlights this universal applicability.

The question, whether these structural properties characterise an integrated environmental policy, requires a rigid formal model – which is not the aim of this practical-minded approach. However, owing to obvious parallels to the market mechanism, a positive answer is not unlikely. The origin of these constitutive elements are to be found in corresponding aspects of the market mechanism.

For a concrete waste policy, these abstract structural properties have to be 'filled' with appropriate tools and instruments, which coordinate individual decisions to achieve the policy goals. This corresponds to the task of the price system in a market system. In general, a mixture of tools, linked in an appropriate way, will be necessary to design a functioning policy.

Thus, the structural properties are the same for any integrated environmental policy, but the policy tools are dependent on the concrete goals of the policy. This results not only from the fact that a WEEE policy typically needs other tools than a policy for end-of-life vehicles. The available technical infrastructure affects also the feasibility of certain policy tools. Moreover, often various tools are available and a decision has to be made as to which one to adopt.

This is the topic of many publications on holistic policies, applicable also to integrated environmental policies. Common evaluation tools, such as SWOT analyses, cost-benefit analyses and others, can be applied in these cases to make a justified decision. For example, Gallardo et al. (2010) and Gallardo et al. (2012) use indicators to quantify the efficiency of certain waste collection systems for household waste in Spain.

Bovea et al. (2010) and Puig et al. (2013) employ life cycle assessments for the management of solid waste and industrial waste, respetively, and Bernad-Beltrán et al. (2014) base their analysis of selective collection of biowaste on semi-structured telephone interviews. With respect to EPR, Rodrigues et al. (2016) develop an input–output model to assess the impacts of an EPR system.

The next section is now devoted to introduce and discuss the structural properties, the constitutive elements, of relevance for any integrated environmental policy.

Constitutive elements of integrated environmental policies

The market mechanism as a prominent allocation mechanism yields equilibrium solutions of the allocation problems with certain characteristic properties. Integrated environmental policies, characterised by constitutive elements, are meant to supplement the market mechanism in the context of environmental commodities. The following constitutive elements (CE) will be discussed in the context of real life examples in the following sections:

CE I: Dependence of the policy on local conditions – Feasible solutions of the allocation problems, in particular market solutions, depend on local conditions. This should be reflected in the integrated policies.

CE II: Integrating affected economic agents into the policy and addressing a potentially large number of involved agents by means of appropriate framework conditions – The allocation problems in a market system are interdependent. Therefore, any interference with the allocation problems can affect a multitude of economic agents. This should be taken into account in integrated policies.

CE III: Identifying appropriate signals and linking them adequately through policy tools – In a market economy, individual agents, consumers and producers, use the price signals to formulate their demand and supply decisions. Owing to the existence of external effects, environmental policies have to be made dependent on other, additional signals.

Aspects of 'Extended Producer Responsibility' are of some relevance in each one of the examples presented in the article. We therefore discuss briefly this generic holistic approach to environmental policy, which has gained importance in environmental legislation in recent years. Thereafter, we turn to the constitutive elements. Various additional references to EPR policies are made throughout the article.

EPR

The fundamental guidelines of the OECD define EPR as 'an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle' (OECD, 2001; or Walls, 2006: 1).

In all practical applications, EPR should provide incentives for producers for a DfE, such that, for example, disassembling their products after the product's lifetime becomes far easier. More precisely, an EPR policy is, again according to OECD (2001), mainly characterised by the shifting of responsibility (physically and/or economically; fully or partially) upstream toward the producer and away from municipalities (and, therefore, also from households).

From an economic point of view, the definition of EPR raises the following question: If an EPR policy should motivate producers for DfE, this definition seems to blame, at least in the first place, the producers for some environmental problems, some pollution or some environmental degradation associated with their products. The role of the consumers seems to be neglected, although demand for a particular design of certain commodities may lead to the environmental problem in question. Without any further policy guidance, producers are likely to pay attention mainly to the market situation. In this context, one must not forget that typically only the producers have the knowledge required and relevant for a DfE of their products. Policy-makers are therefore dependent on the cooperation of the producers, and this 'cooperation' must be stimulated through appropriate policy tools. Thus, DfE will only happen if the market situation is – by chance – in favour of environment-friendly designs.

This view seems to be supported by Gupt and Sahay (2015). In their study ascertaining the most important aspects of cases of EPR from developed and developing countries, they arrive at the conclusion that the 'success of EPR depends on the upstream management …', and that 'changes in the design of the products to reduce environmental impacts (DfE) … do not seem to have a major role in the success of EPR …' (Gupt and Sahay, 2015: 609).

Also, according to Massarutto, 'EPR has become a cornerstone of solid waste management policies throughout the world' (Massarutto, 2014: 11). He argues, 'that policies inspired by EPR have been indeed successful, but probably for different purposes and for different reasons than initially believed' (Massarutto, 2014: 11), and concedes at the same time 'the impact of EPR on green design and product innovation has been much lower than expected' (Massarutto, 2014: 14). It is likely that the reason for the latter observation is a result of the, in general, incomplete specification of EPR policies.

Consequently, postulating DfE by means of a simple command policy will, in general, not be enough, and EPR policies risk violating CE II by neglecting the role of consumers, thereby losing effectiveness.

EPR seems to provide an easy way to put the burden of environmental pollution on others; in this case on producers. Of course, producers should not and cannot be dismissed – they too are responsible for the protection of the environment. However, they are also dependent on their customers, and EPR policies should therefore respect the preferences of the consumers in order to benefit the environment even more. Wiesmeth and Häckl (2011) discuss these and some other aspects of relevance for an EPR policy.

Constitutive Element I: Dependence on local conditions

Remark: *This first constitutive element is meanwhile recognised in many holistic environmental policies. It justifies, for example, that IWM policies differ across regions.*

Feasible solutions of the allocation problems, in particular market solutions, depend on local conditions. These include wealth and preferences of the consumers, production possibilities, availability of natural resources, climatic and geographical conditions, the economic situation in general, trade relations and, in the context considered here, the technical infrastructure. Consequently, the integration of the relevant environmental commodities into the allocation problems, the basis for a well-designed environmental policy, postulates the careful consideration of the local situation. Thus, one should not transfer the details of an integrated environmental policy applied in one country to another country, without a closer look at the relevant local conditions.

This issue refers also to the 'harmonization efforts' in the EU. Bartl (2014) addresses the EU Waste Framework Directive (WFD) 2008/98/EC with its sometimes unifying and standardising attempts. The same critique applies to many of the other EU Directives in the broader area of waste management. Also in this context, Broitman et al. (2012) draw the attention to schemes of waste management, which are often designed at a national level with local conditions neglected.

What is, however, perhaps still acceptable for the member states of the EU with their comparable standards of living, might be critical for countries or regions with greater relevant differences regarding the local conditions. Arlosoroff (1991) points to these problems in the early years of IWM already, and Agamuthu and Victor refer to 'the pitfall of … the simplistic adoption of policies and legislations from other countries' "purportedly" successful waste management system without taking into context the local, cultural and socio-economic waste management issues' (Agamuthu and Victor, 2011: 952).

Changes in the technical infrastructure have an effect on the local conditions, too. They can support or weaken an environmental policy. Gallardo et al. (2010) identify and investigate different collection systems for household waste in Spain. Interestingly they find that 'the percentages of separation at source of paper/cardboard and lightweight packaging are still far from reaching the targets set by law' (see the Abstract). Probably, an adequate incentive structure integrating the households in the sense of CE II and observing CE I should complement the technical environment.

In a related context, Lewis et al. develop a life cycle-based framework to optimise the collection and treatment of waste. They also state that 'given the complexity of SWM [solid waste management], even subtle changes to SWM programs pose potential for unintended environmental consequences' (Lewis et al., 2013: 51), and Marshall et al. (2013) contrast 'the history and current paradigms of SWM practices and policies in industrialised countries with the current challenges and complexities faced in the developing country SWM' (see the Abstract).

The meanwhile broad acceptance of this first constitutive element cannot yet be confirmed for the second: Integrating involved agents and addressing them with adequate framework conditions. Marshall and Farahbakhsh note in this context that prior to 2000 none of the models in SWM 'considered involving all relevant stakeholders' (Marshall and Farahbakhsh, 2013: 988).

Constitutive Element II: Integrating affected economic agents and addressing a potentially large number with appropriate framework conditions

Remark: *All agents, who are affected by the goals of a certain environmental policy, have to be integrated into this policy. 'Affected' thereby means that if a group of agents is not adequately integrated into the policy, these agents might significantly change their economic behaviour, thereby undermining some of the goals of the policy. This constitutive element is recognised in an increasing number of publications on holistic policies, although the requirement of addressing a potentially large number of agents has not attracted much attention so far. Command-and-control policies are often dominating. Due to control costs they are, however, more suitable for addressing a small group of agents.*

Besides the relevance of local conditions, it is a general observation that the allocation problems in a market system are interdependent. This means that any attempt to modify the solution on one market typically has consequences for the solution on other markets. Therefore, any interference with the allocation problems, also regarding the infrastructure, can affect a multitude of economic agents. Consequently, an integrated environmental policy has to respect these agents adequately. This sounds straightforward, although there are crucial consequences. Heidrich et al. (2009) applied the 'affect criterion' in a template and matrix model in order to identify stakeholder groups, which may vary, of course, with the problem in consideration. For a policy maker, the immediate consequence is to identify the 'affected' economic agents and, equally important, to integrate them adequately into the policy.

Functional holistic environmental policies, as a substitute for the market mechanism, should therefore integrate all relevant (or 'affected') economic agents. Referring again to IWM as an example, waste management should address all households – first, of course, with respect to all issues pertaining to the collection and separation of waste, but also with respect to waste reduction, where the cooperation of the households is needed in particular. Taylor (2000) addresses incentives for individuals in this context, and Salhofer et al. (2008) show that the prevention potential can reach some 10% of the relevant waste stream with clear evidence of the environmental benefits (see Gentil et al., 2011). The unsatisfactory situation with the environmentally friendly collection of WEEE in various industrialised countries, investigated by Ongondo et al. (2011), illustrates exactly this point. Similarly, Guerrero et al. (2013) find that 'waste management involves a large number of different stakeholders, with different fields of interest. … Detailed understandings on who the stakeholders are and the responsibilities they have in the structure are important steps in order to establish an efficient and effective system' (Guerrero et al., 2013: 227). Of course, 'stakeholders' are synonymous for affected agents.

Barr et al., for example, point to the need to 'understanding the complexities of how households deal with waste in the home', and they highlight 'the roles of producers, consumers, retailers, local authorities and the waste management industry as key stakeholders' regarding any attempts to prevent waste and favour reuse (Barr et al., 2013: 68). Besides mentioning the relevance of local solutions in solid waste management, Caniato et al. postulate that experts in solid waste management must take into account 'the complex interaction of stakeholders', potentially enhanced through social network structures (Caniato et al., 2014: 939) (see also Uyarra and Gee (2013) for the relevance of the 'networked infrastructures').

An interesting aspect in this context refers to the role of the informal sector in IWM. Lange argues that a 'ban of informal sector activities would be socially counterproductive' (Lange, 2013: 1323). Paul et al. (2012) show how the elaborate integration of the informal sector into municipal solid waste management in Iloilo City, Philippines, helps to observe local conditions and provides positive effects both for the workers in the informal sector and the environment.

Kalimo et al. (2015) relate EPR, mainly in the context of WEEE, to the roles of various stakeholders. In particular, their article 'analyzes the creation of design incentives …' (Kalimo et al., 2015: 41). It examines the question 'what should fall within the scope of a producer's responsibility and what should fall within the responsibility of other stakeholders' (Kalimo et al., 2015: 41). Thus, in view of the current approach to integrated policies, the need to integrate other stakeholders into EPR has been clearly addressed in this article.

Moreover, these considerations show that environmental policies often need to address a large number of economic agents. However, owing to the highly probable tragedy-of-the-commons-like behaviour, classical command-and-control policies require the more or less continuous monitoring of the compliance of the economic agents with the environmental regulations. As this is in general difficult, costly and politically non-feasible, it seems more appropriate to establish framework conditions to stimulate and motivate households and business companies to a cooperative behaviour in the sense of the goals of the integrated environmental policy. Taylor arrives in this context at the conclusion that the success of command-and-control regulations is 'clearly linked to the social-psychological and economic incentives' (Taylor, 2000: 409).

Nevertheless, not all holistic approaches to environmental policy respect these requirements adequately. The following are examples with EPR characteristics.

Example 1: End-of-life vehicle (ELV) legislation. ***Remark:*** *As EPR policy in a special field, the ELV legislation addresses relevant economic agents: Owners of an ELV can return their scrap vehicle to the manufacturer at no cost, and manufacturers are expected to recycle returned scrap vehicles. Consequently, manufacturers have some motivation for DfE. However, uncontrolled exports of used and also scrap cars to non-EU countries, pointing to a non-adequate integration of the manufacturers into the policy, render the ELV policy doubtful.*

At first glance, the ELV legislations, in the EU in general and in Germany in particular, seem to have a more favourable impact regarding EPR. Germany's reuse and recycling rates stay consistently above the rates postulated in the ELV legislation thanks to the efforts of the recycling industry (see http://www.umweltbundesamt.de/en/topics/waste-resources/product-stewardship-waste-management/scrap-cars). Moreover, Gerrard and Kandlikar (2007) show that 'legislative factors and market forces have led to innovation in recycling …' and that 'carmakers are also taking steps to design for recycling and for disassembly' (see the Abstract). In this sense, the ELV legislation induces 'links' between the decisions of consumers and producers. The section 'Constitutive Element III: Linked signals for an integrated environmental policy' provides more details regarding the nature and necessity of these links as another constitutive element.

A closer look at Germany, however, shows that in addition to the recovery and recycling of approximately half a million scrap cars in 2012, there are a million used cars exported to EU countries, for which the EU ELV Directive is relevant, and 0.39 million used cars exported to non-EU countries (see again the link to www.umweltbundesamt.de).

As the distinction between a 'used' (or reusable) car and a 'scrap' car is not always perfectly clear, end-of-life vehicles may end up as 'reusable' cars in non-EU countries. Also, owners may prefer to sell their scrap vehicle for a small amount of money instead of returning it without cost to the manufacturer. This situation is aggravated by the fact that the Correspondents' Guidelines No 9 (see EU, 2011), regulating shipment of scrap cars to countries outside the EU, are not legally binding.

Improper vehicle maintenance, and improper dismantling and scrapping activities in developing and transformation countries are the consequence and pose a hazard to health and the environment – in addition to the loss of valuable raw material.

These deficiencies of the current ELV legislation result also from the lack of a clear definition of a reusable car in distinction to a scrap car. And, each scrap car exported need not be recycled at presumably high costs: There are vested interests stimulating exports of used cars in poor shape.

Returning to CE II, the ELV policy thus does not adequately integrate car manufacturers. In view of these vested interests, the decision on whether a car is reusable or a scrap car, and what should happen with it, should be transferred to a neutral institution, a 'compliance scheme'. This issue is also of relevance for WEEE policies and discussed in the section 'A proposal for an integrated WEEE policy'.

The ELV legislation is not only an attempt to EPR in car manufacturing, but also a guideline to 'individual producer responsibility' (IPR). Rotter et al. (2009) consider IPR as a further development of EPR, with producers bearing responsibility exactly for their products only, a situation that characterises end-of-life vehicles returned for recycling. The question posed by Rotter et al. (2009) is then, whether the obligations according to the verified shares of clearly identifiable WEEE, provide stronger incentives for DfE. Some degree of IPR seems to be indeed necessary for an effective integrated environmental policy. Without IPR, there will likely be incentives for appropriate avoidance strategies, rendering the environmental policy ineffective, as the above considerations regarding significant exports of used cars show. In view of our approach, IPR corresponds to the second and, in particular, to the third constitutive element. See also van Rossem (2008) for more aspects of IPR in the WEEE Directive of the EU.

Summary ELV Legislation

CE I: There is a dense network of companies to take back, treat and recycle ELVs in Germany and the other member states of the EU.

CE II: The framework conditions with the take back requirement at no cost to the car holders do not adequately integrate car manufacturers with the consequence of a significant number of scrap cars ending up in non-EU countries.

CE III: The actions of the car holders (returning many ELVs) generate IPR, at least to some extent, and provide a signal for DfE, though weakened through scrap cars in non-EU countries, to reduce recycling costs.

In the context of integrated environmental policies, framework conditions should replace classical command-and-control policies, if it is necessary to address a large number of economic agents with comparatively small control costs. Vice versa, if one attempts to solve an environmental issue, which requires the cooperation of a large number of agents, by directing the policy only to a small number of agents of a particular group or to the agents on one side of the market only, one should be prepared for surprises. The following example of the 'German refillable quota issue', which is moreover an example for violating the principle of integrating all stakeholders, helps to clarify this point. Interesting to note: The deficiencies of this regulation are not the result of non-compliance with the regulation.

Example 2: The German refillable quota issue. ***Remark:*** *The earlier regulations regarding refillable drinks containers in Germany did not address consumers as an important group of stakeholders, as a group of affected agents. The missing integration of the consumers into the policy caused its failure resulting in a lock-in effect.*

The purpose of the German Packaging Ordinance is to avoid or reduce the environmental impacts of waste arising from packaging. In order to achieve this purpose, the ordinance rightly stipulates to regulate the market behaviour of all concerned parties. In its current version, among other things, the ordinance aims to increase the share of beverages filled into reusable drinks packaging and ecologically advantageous one-way drinks packaging to at least 80% (see Germany, 2009 for an older English version).

The refillables quota issue has its roots in the first versions of the Packaging Ordinance (see Germany, 1998). There is a general obligation to charge a deposit on non-reusable drinks packaging (see Germany, 1998: § 9). However, till 2003, there was an exemption from the obligation to charge deposits as long as, roughly speaking, the combined proportion of drinks packaged in reusable packaging stayed at or above 72%, the actual share in 1991 (see Germany, 1998: subsection 9(2)).

Of course, these regulations to divert packaging and to reduce packaging waste focused almost exclusively on the producers: With the threat of a mandatory deposit, they should increase the share of refillable drinks containers. The regulations did not directly address the consumers, although their drinking habits could have a sizable influence on this combined share of reusable drinks containers.

Nevertheless, the policy failed, the refillable quota has dropped far below 72% since 1991 to less than 50%, and the German government had – according to the regulations of the Packaging Ordinance – to implement the deposit scheme in January 2003. It is a fact that Germany is now locked into a system it did not really want in the first place. This 'lock-in effect' results from the development and installation of quite sophisticated machinery to take back empty drinks packages and return the deposit fee.

One of the main reasons of this unintended development was the requirement of a 'combined' quota of refillable drinks packages: Consider a producer of drinks offering a certain share of drinks in reusable packages. This producer will raise the share of drinks in refillable containers only, if customers are expected to increase their demand for drinks in refillable containers. In addition, such a move means investments in new equipment and higher variable costs for additional logistics services. The argument that the producer could thereby prevent the mandatory deposit fee is not decisive: It is always better to let other producers go ahead with their risky investments and profit then from their decisions. This phenomenon, which is observable in other environmental contexts, is the well-known Prisoners' Dilemma.

In summary, this reasoning does not imply that the deposit fee does not affect drinks producers. It just means that the requirement on the size of the combined share does not play a decisive role in decisions regarding the individual share. In this sense, this policy violated the IPR property mentioned above.

Clearly, the missing integration of the consumers into this environmental policy is to blame for the unintended and at that time certainly unexpected result, thereby demonstrating the necessity of the second constitutive element of an integrated environmental policy. Producers focused on the preferences of their customers and not so much on this combined proportion, which they individually could not or did not want to affect anyway. Ferrara and Plourde (2003), who analyse the effects of various regulatory measures on producers' choices regarding packaging in the presence of consumers with differing demand intensities, support this view. One of their conclusions is that 'inducing consumers to recycle and return packaging becomes an essential facet of the problem' of increasing the market share of reusable packaging (Ferrara and Plourde, 2003: 10).

Among other possibilities, a system of tradable certificates for one-way drinks containers allows integrating the large number of consumers into such a policy in an appropriate way. In this case, consumers would likely be obliged to buy drinks in one-way containers at higher prices, the costs of the certificates would raise consumer prices. This would affect their consumption behaviour – thus integrating them into the environmental policy and re-establishing the IPR property.

As already mentioned, the current version of the German Packaging Ordinance aims to increase the share of reusable drinks packaging and ecologically advantageous one-way drinks packaging to at least 80%. However, beyond the advice: 'The Federal Government shall conduct the necessary surveys on the respective shares and shall publish the results annually in the Federal Gazette' (see Germany, 2009: Section 1(2)), there are no instruments with which this goal could or should be attained, there is no further guidance of the economic agents, neither producers nor consumers, to comply with this goal. A difficult endeavour, in view of the lock-in effect mentioned, and also in view of the missing constitutive element of an integrated environmental policy.

Summary refillable quota issue

CE I: The situation regarding drinks in Germany in the 1990s technically allowed both refillables and one-way containers, but was ready for a higher share of refillables.

CE II: The policy addressed only producers. The fact that consumers were not integrated into the policy through appropriate framework conditions induced its failure.

CE III: The demand and supply decisions of the consumers and producers regarding refillables provided signals, which were linked, but unfortunately not with the goals of the policy.

Another policy issue is the (possible) ban of the herbicide Glyphosat in the EU. The following example discusses this issue with the focus on integrating affected agents.

Example 3: The (possible) ban of glyphosat. ***Remark:*** *A ban is a common policy tool for preventing the use of hazardous materials or processes. It constitutes a simple command-and-control policy, typically referring to producers and users of these materials or processes. The question that arises in the context considered here is, whether these producers and users constitute the only group of affected agents in the sense of CE II?*

The EU member states are currently discussing the possible ban of the wide-band herbicide Glyphosat. Of course, the ban refers to the chemical and the agricultural industry. As there is only a relatively small number of producers, distributors and importers of this herbicide, it should be no problem to monitor this ban, which immediately includes the agricultural industry. If the chemical industry in the EU continues to produce Glyphosat for the export markets (outside the EU), the policy makers have to decide whether this should be allowed or not.

What about consumers? Will they be 'affected' by this ban in the sense of CE II or not? In order to investigate this issue, assume that the ban of Glyphosat will raise costs for agricultural products all over the EU, followed by price increases. At least some of the agricultural products could be imported from outside the EU, perhaps at lower prices. If these imported agricultural goods are still produced with the application of Glyphosat, an interesting question arises, even if the herbicide is not detectable in the imported products: Shall we allow that we consume agricultural goods, which are produced by means of a chemical, which can be hazardous to the people in the exporting countries?

If the policy makers arrive at an affirmative answer, then consumers have to be integrated into this policy, they are 'affected', as with their buying behaviour they risk to undermine the goals of the policy. There are a couple of ways to address this large number of consumers, to integrate them into the policy. First, importers of agricultural products could be forced to label these products accordingly, if produced with Glyphosat. Then the purchasing decision is left to the consumers. Or, a (Pigou) tax is levied on these imported products, which again leaves the purchasing decision regarding the now more expensive imports to the consumers. Alternatively, there could be a ban on these imports. In this case, consumers are also integrated in the policy in the sense that they are forced to reorient their purchasing decisions. Observe that the last two options may not be feasible regarding regulations of the World Trade Organization (WTO).

This example clearly shows that the question regarding affected agents is depending on the details of the policy and its goals.

Summary (possible) ban of glyphosat

CE I: The agricultural industry in the EU could probably produce without applying the herbicide Glysophat.

CE II: A ban of Glysophat affects the chemical industry, of course, the distributors and the importers, and then the agricultural industry. Whether the consumers constitute a group of affected agents, depends on the detailed goals of the policy.

CE III: As there is only a small number of producers, distributors and importers of Glyphosat, a ban of selling Glyphosat in the EU as a special command-and-control policy is an appropriate tool, which immediately extends to the agricultural industry. If consumers have to be integrated into the policy, then additional tools are necessary. In this case the signals to be monitored refer to imported commodities produced with the application of Glyphosat. As a ban of Glyphosat in the EU leaves no room for the industry, there is no need to link these signals to production activities of the industry in this case.

So far, these issues of determining the groups of affected agents and of addressing a potentially large number of agents with suitable framework conditions have not yet attracted much attention in the literature. Nevertheless, they result from the integration of the environmental commodities into the allocation problems, and from a careful analysis of the available policy tools.

The following considerations, which are of similar importance for an integrated environmental policy, will refer to signals on which economic agents base their decisions. Identifying appropriate signals and linking them through appropriate policy tools constitutes the last essential element of an integrated environmental policy.

Constitutive Element III: Linked signals for an integrated environmental policy

Remark: *This last constitutive element is for various reasons the most important one and at the same time the most difficult one to implement. There is not much visible in the literature so far.*

In a pure market economy, individual agents, consumers and producers, use the price signals to formulate their demand and supply decisions. The observable prices and expected future prices for regular commodities contain, in general, sufficient information for optimal decisions. With the presence of environmental commodities, however, price signals are either missing, because of the public goods property of certain environmental commodities, or are distorted owing to external effects. Consequently, effective environmental policies are dependent and have to be made dependent on other, additional signals. Usually, more than one signal will be necessary to provide and disseminate the relevant information. As some of these signals are more important for consumers and others more important for producers, it is an immediate consequence that these signals, which are basic for an integrated environmental policy, have to be linked through the policy by means of appropriate policy tools. Observe that this requirement is automatically satisfied in a pure market economy, where both consumers and producers rely upon the same price signals providing complete information. Moreover, market prices are interdependent and 'linked' through the markets.

Relevant signals typically refer to different stages of a product's lifecycle, including the design and the post-consumer stage. According to OECD, 'EPR seeks to integrate signals related to the environmental characteristics of products and production processes throughout the product chain' (OECD, 2001: 9). McKerlie et al. (2006) highlight EPR programmes 'with clear legislation that encourages sustainable product design by delivering a full range of signals to producers' (see the Abstract). The task of an integrated environmental policy is then to select the appropriate signals with relevance for all stakeholders, not only for producers, and to link them through suitable instruments such that the policy goals can be achieved. This is, as experience shows, a challenging task, which is not always simple and straightforward.

To some extent Cossu and Masi (2013) confirm this point. In their analysis of the development of the management of municipal solid waste in Italy, they observe 'a steady transformation in terms of technology and organization' with legislation as the driving force of the system and economic measures in the form of incentives and penalties added later. One of their conclusions is that these economic measures 'had often motivated technological and organizational solutions not otherwise justifiable' (Cossu and Masi, 2013: 2541). This points to missing constitutive elements of the policy, in this case to missing signals or insufficiently linked signals.

The WEEE legislations in various industrialised countries provide interesting examples for this issue. The background is that the amount of e-waste is rapidly growing, especially, but not only, in the industrialised countries. (In 2011, there were 1.5 mobile phones per capita in Russia, 1.36 in Brazil, 0.75 China and 0.70 in India. In comparison, there was approximately one mobile phone per US citizen (see http://www.rediff.com/business/slide-show/slide-show-1-tech-india-among-nations-with-most-mobile-phones-in-the-world/20130510.htm#1).) Thus, attention has focused on regulations to handle WEEE in a responsible and environment-friendly way. Nevertheless, unsafe handling of WEEE is a common observation for most of the developing world, aggravated by semi-legal or even illegal exports to those countries (see Li et al. (2013) for a survey on source and destination countries for WEEE). Industrialised countries are also worried about the future environmental impacts of the large amounts of WEEE or parts of it that are currently landfilled (Babu et al., 2007; Janz and Bilitewski, 2009; Oguchi et al., 2012; Ongondo et al., 2011).

In order to further motivate the third constitutive element, the following example investigates the internal structure of the WEEE legislation in the EU, based on the European Directive on WEEE (EU, 2012). The current version of the German ElektroG (Germany (2015) follows this Directive closely, and WEEE policies in other countries can be analysed in a similar way. The fact that there are different approaches to WEEE is in accordance with the principle of dependence on local conditions discussed in the section 'Constitutive Element I: Dependence on local conditions'.

Example 4: The Directive of the EU on WEEE. ***Remark:*** *The signals associated with the decisive regulations of WEEE policies based on the EU Directive are not sufficiently linked to motivate the economic agents to fully comply with the goals and the letter of the regulations in a context of limited control possibilities by the authorities.*

The decisive regulations of the EU Directive (EU, 2012) refer to product design, separate collection of WEEE including a mandatory take-back system and treatment of waste equipment. These four policy areas are, in fact, characteristic for most WEEE regulations in industrialised countries. Differences refer mainly to the details of the requirement of a separate collection and the structure of the take-back system. These specifications allow a careful investigation of quality and origin of the signals and the integration of the signals into the policy. The links between these signals deserve particular attention. See also BIO Intelligence Service (2013) for a review of the scope of this WEEE Directive of the EU.

- *Product design*: Article 4 of the EU Directive postulates: 'Member States shall take appropriate measures so that the ecodesign requirements facilitating re-use and treatment of WEEE … are applied …'. The associated signal refers, of course, to the degree of DfE, to the degree of implementation of the required design modifications for electrical and electronic equipment.
- *Separate collection*: Paragraph 1 of Article 5 stipulates a separate collection of WEEE: 'Member States shall adopt appropriate measures to minimize the disposal of WEEE in the form of unsorted municipal waste, to ensure the correct treatment of all collected WEEE and to achieve a high level of separate collection of WEEE …'. The associated signal, the share of WEEE collected separately, addresses primarily consumers, and affects their transaction costs.
- *Take-back system*: Paragraph 2 (a) of Article 5 demands that 'Member States shall ensure that systems are set up allowing

final holders and distributors to return such waste at least free of charge …'. Moreover, according to Paragraph 2 (d) of Article 5 'producers are allowed to set up and to operate individual and/or collective take-back systems for WEEE from private households …'. As these regulations leave some degrees of freedom, they deserve some closer inspection in view of the issue of IPR addressed in Example 1.

- *Treatment*: According to Paragraph 1 of Article 8 'Member States shall ensure that all separately collected WEEE undergoes proper treatment'. Paragraph 2 of Article 10 stipulates that: 'WEEE exported out of the Union shall count towards the fulfilment of obligations and targets … if … the exporter can prove that the treatment took place in conditions that are equivalent to the requirements of this Directive'. These articles address producers and leave them some room for making decisions, not much affected, however, by other signals or decisions. Again, these regulations deserve closer inspection.

It is important to note that these signals cover relevant stages of the product chain of electrical and electronic equipment. Moreover, if producers and consumers fully complied with the letter of these regulations, the Directive and the more specific ElektroG could certainly achieve their goals. However, the 'chain of incentives' provided by these policies have some weak points, which are responsible for various critical developments regarding collection and export of WEEE.

The separate collection of WEEE, stipulated for owners of WEEE in all versions of the EU Directive and the ElektroG, is costly, at least in terms of time needed to transport pieces of WEEE to the collection points. Without a strict enforcement, which is in general not feasible, consumers will not always comply with this regulation. The 'Tragedy of the Commons' can misguide consumers to put small WEEE into the garbage collection or to 'donate' other pieces of WEEE to private collectors for export. For example, Janz and Bilitewski (2009: 116), found that 1% of the municipal waste in Germany consists of discarded small electrical and electronic appliances, which can constitute more than 50% of the total heavy metal load in household waste with possibly severe consequences for the mechanical–biological treatment of waste and the groundwater.

Moreover, in accordance with the first constitutive element, the principle of dependence on local conditions, commodities can be valuable enough to be reusable and reused in some developing countries, but not in the country of origin. This view is supported by the required 'check' prior to treatment as to whether the waste equipment can be sent for reuse, leaving some room for decision-making and pondering.

Of course, most consumers in the industrialised countries will – owing to their supposedly high environmental awareness – take WEEE to the official collection points. Tempting opportunities remain to discard small WEEE with the domestic garbage. Again, as Gallardo et al. (2010) and Lewis et al. (2013) point out, appropriate technical infrastructures might contribute towards better collection results. The question remains, to what extent suitable policy tools might help in this regard.

Manufacturers do not have to take back and treat WEEE that is not returned according to these regulations. In ambiguous cases, they will decide in favour of a reuse, of exporting waste equipment, at least as long as this seems the cheaper alternative for them. The signals regarding the decisions of the consumers have no effect on them. As reports from Germany show, in spite of political efforts to reduce semi-legal and illegal shipments of WEEE out of the EU, these activities seem to continue (http://www.umweltbundesamt.de/en/press/pressinformation/export-of-waste-electrical-electronic-equipment). This apparent non-compliance with the regulations and the letter of the regulations is an indication of a policy failure. Babu et al. refer to the word 'recycling' that obviously helped industrialised countries 'to justify the free trading of hazardous materials to the developing countries …' (Babu et al., 2007: 311).

Gui et al. (2016) analyse cost allocations in collective EPR systems with large collection and recycling networks, thereby developing cost allocation mechanisms that stabilise participation in such systems and guarantee an allocation of the recycling costs, which largely corresponds to the returned WEEE of the participating manufacturers. Observe that the focus of this article in this context is more on potential vested interests of manufacturers in EPR systems (see also Kalimo et al., 2015: 49). To make it clear: Collective systems need not contradict integrated waste policies, if there is consensus on the cost-allocation as indicated here.

What are then the incentives of the manufacturers to implement the signals referring to product design, again without strict control from the authorities, which is not feasible in this situation anyway? Producers will change the design in favour of an ecodesign, if the new design remains attractive for customers and/or is less costly to handle than the previous one – over its lifetime including recycling, or if increasing revenue helps to cover rising costs. Again, if it remains possible to export substantial shares of WEEE, aggregate disassembling and recycling costs will decrease, providing less incentive for DfE. Thus, under these circumstances, only the purchasing decisions of the consumers have a substantial effect on the activities of the producers. In particular, there is no significant link between the collection rates of WEEE and DfE.

The concept of IPR mentioned above could stimulate DfE (see also Walls, 2006: 31ff, for an analysis of different payment schemes in the context of IPR in the Dutch WEEE policy), if it is supported by appropriately linked signals. See also van Rossem (2008) for more details on IPR in the WEEE Directive of the EU.

Summary EU Directive on WEEE

CE I: The regulations regarding collection points and recycling possibilities for WEEE are in accordance with the local conditions in the EU.

CE II: The policy addresses producers (DfE) and consumers (separate collection), but the framework conditions do not address these agents appropriately to comply with the regulations.

CE III: The decisions of the consumers and producers yield signals, which are, however, insufficiently linked with the goals of the policy.

The following section proposes an integrated environmental policy for WEEE. The focus is thereby on the links between appropriate signals providing the intended incentives.

A proposal for an integrated WEEE policy

Remark: *The signals in this WEEE policy are taken from the decisive regulations of a WEEE policy and linked through appropriate policy tools to guide the economic agents to comply with the policy goals.*

Consider the following approach: Owners of WEEE get a 'refund' for returning e-waste to an official collection point. The refund depends on the category and on some other characteristics of the end-of-life product. Of particular importance is the dependence of the refund on the degree of difficulty to disassemble the equipment, thus, on DfE, and perhaps on the market value of the recyclable substances.

There is already some practical experience with this kind of refund. Zhu et al. (2012) report on the 'trade-in policy for home appliances and electronics' implemented in China in 2009. According to this policy, (registered) consumers in the pilot provinces and cities can gain a 10% subsidy on a new product if they provide an old one (Zhu et al., 2012: 1217). Besides stimulating demand for new products, this trade-in policy effectively promotes the collection of WEEE (Zhu et al., 2012: 1218, Table 4). However, for EPR this special trade-in policy alone is not yet sufficient (Zhu et al., 2012: 1220). In particular, there is no stimulus for DfE, and some consumers started to exploit the system by buying cheap second-hand products just to get the subsidy on a new product (Zhu et al., 2012: 1219). Parts of the policy are, thus, linked in a wrong way.

Moreover, one could also apply the concept of a deposit fee on electrical and electronic equipment (EEE) to stimulate separate collection of WEEE – similar to the mandatory deposit fee on non-reusable drinks packaging in Germany (see Example 2). According to the German Advisory Council on the Environment, deposit schemes are an effective tool, in particular for small EEE, such as mobile phones and computers (Wilts and von Gries, 2016: Chapter 3). There is also some experience with these deposit schemes for EEE in various countries, among them Austria, Italy and the US (see again Wilts and von Gries, 2016: Chapter 3).

The next element in our approach is an independent 'compliance scheme', similar to the compliance schemes for packaging waste in Germany, which producers or importers have to join and which takes back WEEE and consigns it to treatment and recycling (see again Walls (2006: 35ff) for the WEEE policy in Korea). This compliance scheme receives fees from the manufacturers, which depend also on the characteristics of the products mentioned. Moreover, this scheme is in charge of issuing the refunds to the consumers. The scheme of refunds and fees should be balanced over time. The scheme can be compatible with cost allocation mechanisms (see Gui et al. (2016) on this issue), which allow sharing the recycling costs in accordance with returned WEEE of the participating manufacturers.

How to determine the fees manufacturers have to pay for their products? Of course, these fees have to depend on the level of DfE. It should be possible to develop certain (environmentally relevant) specifications that a product should have for DfE, similar to the energy efficiency specifications that have already been introduced for many household appliances, such as refrigerators, washing machines, etc. Some of these energy efficiency regulations extend also to electronic products such as televisions and computers (see, for example, EU (2010)), but technical specifications regarding DfE in general seem still to be missing.

However, after the introduction of certain basic specifications, an integrated WEEE policy will induce manufacturers to provide such parameters, because this will imply a lower fee, or even a subsidy, if their product is above these specifications.

For sure, to determine the fees and refunds is not an easy and straightforward endeavour, as the experiences with the feed-in tariffs for electricity from renewable sources in Germany proved. The too-high tariffs for electricity from photovoltaic modules initiated unplanned and unexpected activities. Consequently, it is necessary to closely observe the relevant situation. On the other hand, there is already some experience with the fees for licensing of packaging material, for example.

The consequence of this approach is a sequence of signals from the product chain with links between them: The consumers have a stronger incentive to return WEEE to official collection points and 'leakage' to export markets declines because export decisions are made by the independent compliance scheme and not by the manufacturers with their vested interest. Then, as the refunds depend on certain characteristics of the WEEE, fees to the compliance scheme and the prices of the new products will depend on these characteristics as well. In particular, there will be higher prices for products without DfE, affecting demand. Thus, manufacturers are affected in two ways: First owing to the higher recycling rates, recycling costs tend to increase. Moreover, higher fees for products with a lower level of DfE can only be sold at higher prices, reducing demand for these products. Therefore, if a higher level of DfE reduces lifetime costs and stimulates demand, producers have a stronger incentive to change the design of their products – without intensive monitoring.

Thus, there is a closed link of signals from product design to taking back and recycling used and waste equipment. IPR enforced through this closed link of signals drives this result, with the compliance scheme neutralising some selfish interests of the producers. This helps in particular to prevent dubious shipments of WEEE to countries out of the EU. This scheme of fees and compensations is linked with, and necessary for, a functional WEEE policy.

The pattern of behaviour necessitating such an approach results from the 'Tragedy of the Commons', and not necessarily from a lack of environmental awareness. Similar remarks, although differing in certain details, apply to WEEE regulations of other countries (see Ongondo et al. (2011) for a survey on many countries, Oguchi et al. (2012) for special aspects of the WEEE policy in Japan, Zhu et al. (2012) and Yu et al. (2014) for the development of a WEEE policy in China and Schnoor (2012) for the situation of e-waste in developing countries).

Observe that Kalimo et al. are to some extent addressing these issues when they conclude that 'in order to divide the responsibilities to create incentives, EPR requires an effective regulatory framework', and '… public authorities have a responsibility to intervene with guidance and regulation in case of market failures' (Kalimo et al., 2015: 53). The approach to an integrated WEEE policy attempts such a regulatory framework.

Summary integrated WEEE policy

CE I: The regulations regarding collection points and recycling possibilities are in accordance with the local conditions in the EU.

CE II: The policy addresses producers (DfE) and consumers (separate collection) with framework conditions, which stimulate compliance with the letter of the regulations.

CE III: The decisions of the consumers and producers yield signals, which are linked through policy tools to the policy goals. In particular, DfE is linked to buying decisions and collection and treatment rates.

Conclusions and summary

The article develops the constitutive elements of an integrated environmental policy. The practical examples associated with these elements demonstrate their necessity for an integrated policy. The interaction of the policy with the technical infrastructure is of practical relevance too, although this issue is not addressed in this article. Integrated environmental policies are then holistic approaches to environmental policies with all qualities of an allocation mechanism for environmental commodities. Moreover, the practical results show that a holistic policy, which violates one of the constitutive elements, risks providing incentives to relevant groups of economic agents such that the policy will at least partially fail.

How to design an integrated environmental policy? The examples presented and discussed in this article show that there is, regarding the concrete choice and linkage of the policy tools, no unique way. Rather, each environmental issue requires its own specific procedure, only the requirement of the constitutive elements is universal. Lindeneg (1992) points already to the need to choose the instruments in accordance with the goals of the environmental policy and the specifics of the environmental problem, and Frederico et al. (2009) develop and apply the 'strategic environmental assessment procedure', which can help to find the right policy tools.

However, the central idea of an integrated environmental policy, namely the integration of the relevant environmental commodities into the economic allocation problems, from which it derives its name, provides some guidelines.

(a) Determine the goals of the environmental policy. In view of a sustainable development, these goals may comprise environmental, economic and social goals.
(b) Consider all local conditions that the environmental policy should respect. This is in agreement with a sustainable development.
(c) Identify all stakeholders in the environmental issue at hand and make sure that all stakeholders are adequately integrated into the environmental policy. These are in most cases producers and consumers, sometimes also located across the border.
(d) Choose the right instruments to address the stakeholders and affect their behaviour. In general, a mix of instruments is required, in particular, if there are multiple goals. For example, command-and-control policies can be used to control and monitor the behaviour of a small group of agents. Framework conditions are better suited to address a larger number of agents.
(e) Critical parts of any integrated environmental policy are the links between appropriate signals required to coordinate the behaviour of the agents. The goal therefore is to overcome the Tragedy of the Commons and/or the Prisoners' Dilemma by means of establishing IPR. In some special cases, such as a ban of certain chemicals, IPR can be achieved directly by a command-and-control policy. In most other cases, however, systems of fees and refunds supported through compliance schemes are required to 'convince' economic agents to assume individual responsibility of the (waste) products.
(f) The performance of a particular policy could be measured according to the share of DfE achieved, or, in the case of IWM, also through more sophisticated measurement tools such as the 'Zero Waste Index' proposed in Zaman and Lehmann (2013) or the 'Strategic Environmental Assessment Procedure' developed by Frederico et al. (2009).

In conclusion, there is an art of designing integrated environmental policies, which consists in establishing IPR, though not necessarily in a 1:1 context. Integrated environmental policies are required to support sustainable development in general, and to handle complex environmental issues in particular (see Wiesmeth and Häckl (2015) for an example regarding chemicals and additives in textiles). Moreover, because of their applicability in contexts of multiple objectives, integrated environmental policies can also help to develop and establish innovative environmental technologies. These policies correspond with the available technical infrastructure. Most often, they also provide incentives for the further development of this infrastructure.

Acknowledgements

The authors are grateful to the reports of anonymous reviewers, who helped to focus the article on the core issues and to improve readability.

Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: Research supported by RSF grant Nr. 15-18-20029 'Projection of optimal socio-economic systems in turbulence of external and internal environment'.

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